Cloud Standardization Trends and Inter-cloud Techniques in ITU-T

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Abstract

Study Group 13 (SG13) of the International Telecommunication Union, Telecommunication Standardization Sector (ITU-T) is reviewing architectures such as those of Future Networks and drawing up cloud standardization specifications in order to design the optimal network when providing services. This article introduces the ITU-T SG13 Recommendations that have been completed through cloud linkages and gives an overview of draft reports that are under review. Additionally, the concepts and specification details of inter-cloud techniques for implementing highly reliable cloud infrastructures being promoted, centering on Japan, are described.

1. Overview of ITU-T cloud standardization

Study Group 13 (SG13) of the International Telecommunication Union, Telecommunication Standardization Sector (ITU-T) is reviewing the architectures of networks such as the Next Generation Network (NGN) and Future Networks [1]. Cloud computing has become increasingly popular recently as virtualization techniques have progressed and business models have matured, and computational resource usage has entered a new era. An important topic for ITU-T SG13 is the optimal network design when providing cloud services, and against that background, we have set up three review tasks and have started drawing up standards relating to clouds from the telecommunications aspect. The scope of the review tasks includes cloud ecosystems, general requirements, functional requirements, and architectures. At SG13 meetings, at least 50 specialists from telecommunications carriers and vendors of software and network equipment gather and engage in active debate. As a result, general requirements for clouds (Y.3501), functional requirements for cloud infrastructure management (Y.3510), and functional requirements for cloud resource management (Y.3520) have been completed as ITU-T Recommendations. Future aims include completing the standardization of individual techniques and service fields such as Infrastructure as a Service (IaaS) and inter-cloud services.

In addition, a collaborative team (CT) has been formed with the cloud related group Subcommittee 38 (SC38) of the Joint Technical Committee 1 (JTC1) of the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC), and a collaborative review is underway into cloud terminology and reference architectures to form common documents [2]. The results of this collaborative review are scheduled to become standardization documents for both fields.

2. Overview of cloud recommendations

The current group of cloud related recommendations for ITU-T SG13 is shown in **Fig. 1**. Documents CT-CCVOCAB and CT-CCRA of the collaborative team with ISO/IEC review the terminology and reference architecture that are the foundations of the cloud standard and that are applied in common to all the ITU-T Recommendations. Among the draft Recommendations that are subject to ITU-T independent review, Y.3501 stipulates the broader concepts of each field to give an overall picture of clouds, and the others stipulate detailed specifications of individual fields. In addition, draft Recommendations Y.e2ecslm and Y.e2ecmrgb are currently being reviewed as recommendations derived from the resource management of Y.3520. An overview of these recommenda-

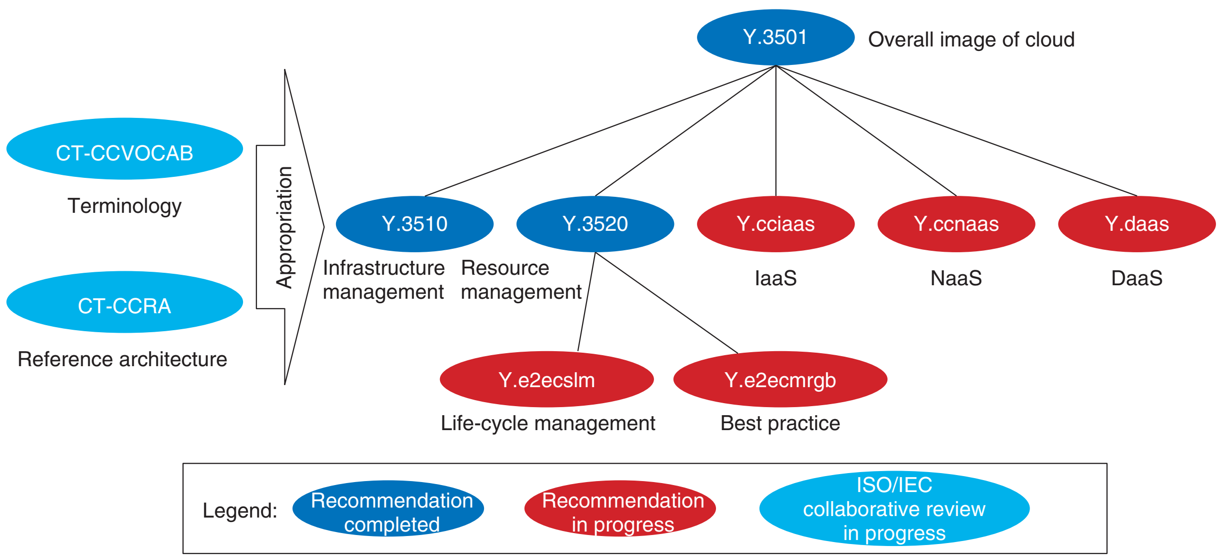

Fig. 1. ITU-T SG13 cloud linkage recommendations.

Table 1. Overview of ITU-T cloud recommendations.

Recommendation No.	Summary	Note
CT-CCVOCAB	Stipulates basic cloud terminology and definitions of ecosystems that represent the roles of providers, customers, etc.	ISO/IEC collaborative review
CT-CCRA	Stipulates reference architecture that shows the positioning within the overall image of each function and associations between functions, for functions such as service provision and resource preparation.	ISO/IEC collaborative review
Y.3501 (Y.ccf)	Derives general requirements based on abstracted use cases of cloud techniques and service fields, and stipulates an overall image of the cloud. Stipulates both requirements common to all services, such as life-cycle management and security, and requirements that are special to fields such as IaaS and Inter-clouds.	Editor: Bo HU (NTT)
Y.3510 (Y.ccInfra)	Subordinate part of cloud architecture—stipulates functional requirements and orchestration relating to the three types of resource for parts that provide installation infrastructure: computing, storage, and networks.	-
Y.3520 (Y.e2eccrmr)	Recommendation Y.3520 stipulates integrated management of services and resources in an end-to-end manner with respect to services configured on one or a number of cloud systems, with the aim of providing applications in the upper layers.	-
Y.ccic	Focuses on resource utilization of net and infrastructure and stipulates the framework of an Inter-cloud that links together a number of IaaS and Network as a Service (NaaS) business operators.	Editor: Naotaka MORITA (NTT)
Y.DaaS	Customized for typical cloud services—stipulates the functional requirements and architecture necessary for providing services, based on use cases that are more detailed, for each of the IaaS, NaaS, and Desktop as a Service (DaaS) fields.	-
Y.ccIaaS		
Y.ccNaaS		
Y.e2ecslm-Req	Stipulates frameworks and functional requirements for the life-cycle management of clouds and services.	-
Y.e2ecmrgb	Reviews methods of implementing end-to-end management by best practices.	-

NaaS: Network as a Service
DaaS: Desktop as a Service

tions is listed in **Table 1**.

Functional requirements and architectures such as Software as a Service (SaaS) and BigData as a Service (BDaaS: B desktop as a service) positioned in

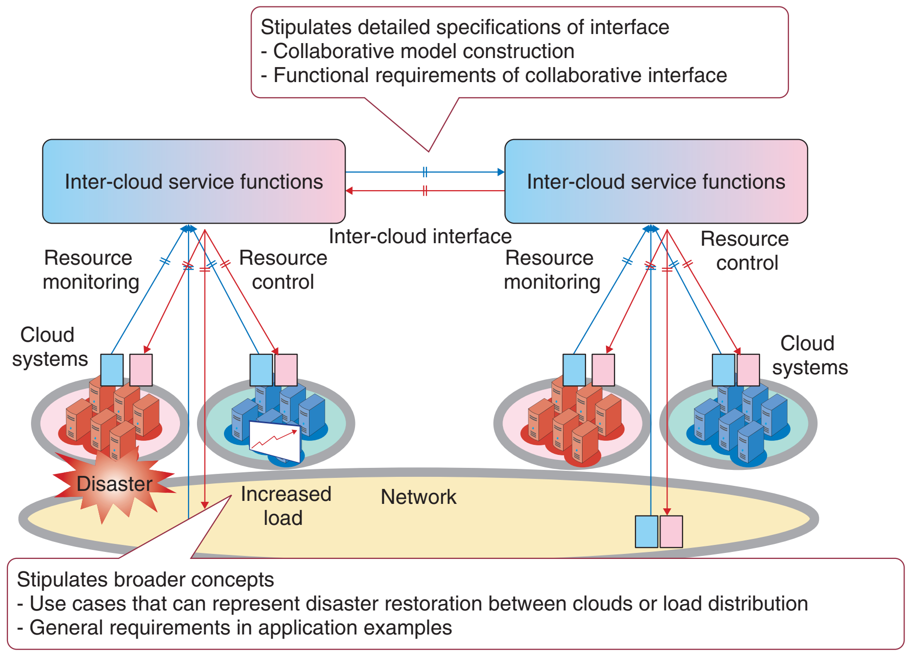

Fig. 2. Overview of inter-cloud techniques.

upper-level layers, have been proposed as new review items, and basic use cases for them are currently under review.

3. Standardization of inter-cloud techniques

Inter-cloud techniques have been proposed that achieve service/resource collaboration among multiple independent cloud systems to increase service/resource reliability in an economical manner, with the ultimate aim being to implement a highly reliable service infrastructure [3]. An overall view of inter-cloud techniques is shown in **Fig. 2**. These inter-cloud techniques flexibly accommodate computational resources such as virtual machines (VMs) between a number of cloud systems, and can be expected to restore services rapidly in the event of problems such as overloads or natural disasters that have a major effect on the provision of services. With inter-cloud techniques, it is necessary to assume interconnections between cloud systems and to stipulate a collaborative interface for accommodating resources, as common standard specifications. There are two main phases to these interface stipulations. It is first necessary to stipulate use cases and general requirements that can be represented comprehensively, such as disaster recovery and load distribution between clouds, as broader concepts. It is then necessary to design models for the collaboration among cloud systems and stipulate functional requirements for interfaces, as detailed specifications. Each of these aspects is described below.

3.1 Broader concepts

For the broader concepts, it is necessary to abstract use cases to make it possible to express the basic concepts of inter-cloud techniques and a wide variety of intended uses. As a basic concept, each cloud service provider (CSP), who is a business operator, provides services to a cloud service customer (CSC), but when a problem occurs with a resource that cannot be dealt with internally, the CSP negotiates with other business operators to make use of their unused resources. We are addressing problems such as server failure due to overload, system disruption due to a disaster, service stoppage due to business reasons, or increases in network lag due to changes in the location of users, as specific applications.

Use cases that abstract these concepts and address problems are shown in **Fig. 3(a)**. There are two ways to address problems: inside the cloud system or outside the cloud system, depending on the use case. When a VM or storage service within a cloud system can no longer be used because of an overload, disaster, or service stoppage, this corresponds to a problem within the system. To counter such problems,

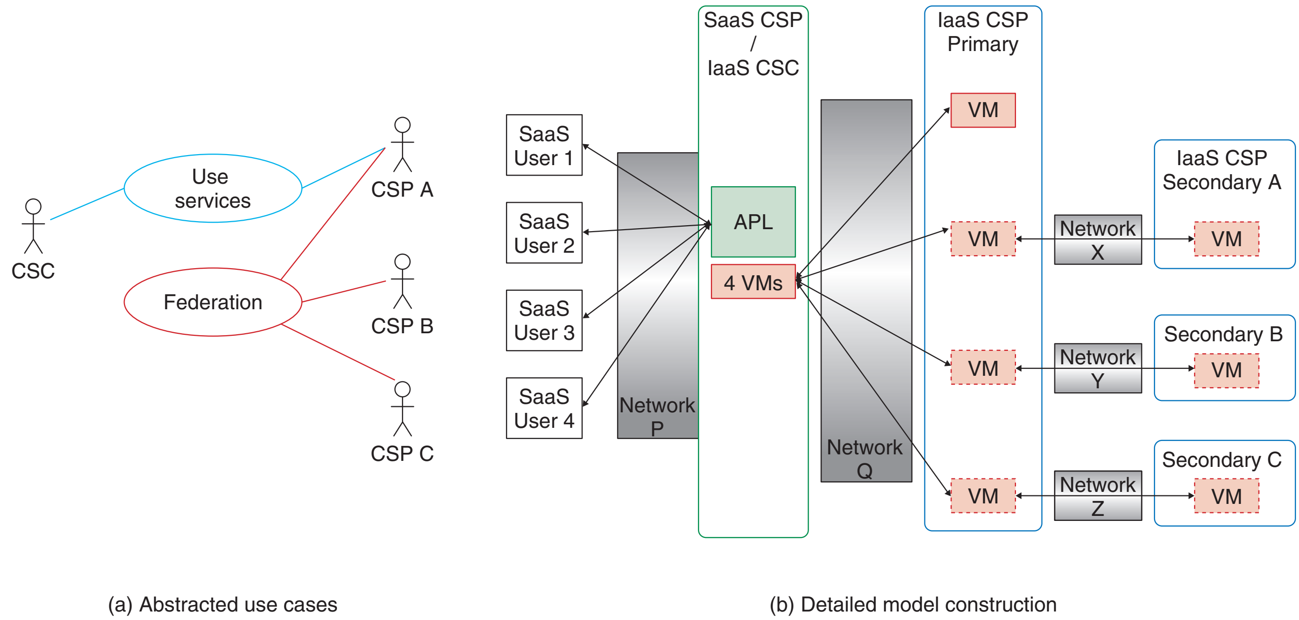

Fig. 3. Abstracted use cases and detailed model construction.

the CSP concerned collaborates with other CSPs and implements continued service usage for the CSC by migrating service functions to a VM or storage system that can be used. By contrast, when a user who has moved to another location, for example, during an overseas business trip, accesses services provided at the original location, network speeds and lag can cause bottlenecks. To counter that problem, the CSP collaborates with other CSPs and implements an effortless service usage for the CSC by following changes in the network environment of that user and migrating service functions to a VM and storage system of another CSP at the optimal location.

In order to implement such use cases, on-demand usage of resources between cloud systems, the distribution of load over a number of cloud systems, large-scale migration that enables simultaneous migration of the service functions of a large number of users, and adaptability to network changes have been proposed in ITU-T recommendation Y.3501 as general requirements in the broadest sense.

3.2 Detailed specifications

To discuss detailed specifications, it is necessary to construct a model of the collaboration between cloud systems that is required for actual service solutions and to embody the functions of a collaborative interface, based on the abstracted use cases.

In real-life businesses, there is a Business-to-Business-to-Consumer (B2B2C) model in which the CSP loans a VM to the CSC as IaaS, and the CSC develops and creates applications on the VM, then provides the applications as SaaS to end users. The construction of the cloud system collaboration model that reflects this B2B2C business model is shown in **Fig. 3(b)**. In this model, applications are constructed over a number of VMs of an IaaS CSP, and issues such as maintenance during normal operation and problem identification during failures are complex. In this case, a proposal has been made to divide roles into primary and secondary roles in order to simplify management, where the primary IaaS CSP has independent responsibility with respect to the IaaS CSCs, and the groups of VMs provided to IaaS CSCs are managed together. The CSP accommodates not only the VMs within its own system, but also the VMs of other secondary CSPs as necessary and provides them to the IaaS CSCs.

In the implementation of this collaboration, a number of Secondary IaaS CSPs are asked through a collaborative interface for computational resources such as VMs from the Primary IaaS CSP; once the optimal resources have been secured, they are provided to users. When they are no longer needed, it is necessary to notify the Secondary CSPs through the interface and release the resources. For that reason, requirements for interface functions such as the reservation, securing, and releasing of resources are being proposed.

4. Future expansion

As the cloud market grows, the completion of standardization specifications such as those for IaaS or NaaS (network as a service), which are currently under review, will have a huge impact on business in the future. In particular, the proposed Recommendation Y.ccic that stipulates inter-cloud frameworks is being reviewed with the aim of achieving consent within 2013. This is expected to simplify interconnections between business operators, contribute to disaster countermeasures, and help jump-start the market by standardizing and popularizing inter-cloud techniques.

References

[1] ITU-T SG13: Future networks including cloud computing, mobile and next-generation networks.
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[2] JTC 1/SC 38: Distributed Application Platforms and Services (DAPS).
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[3] Global Inter-Cloud Technology Forum, 2010 (in Japanese).
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He received the M.S. degree in wireless network engineering from Osaka University in 2010 and joined NTT the same year. He has mainly been engaged in researching inter-cloud technology and cloud network security technology and has also worked on standardization activities of cloud computing in ITU-T and other related standardization organizations.